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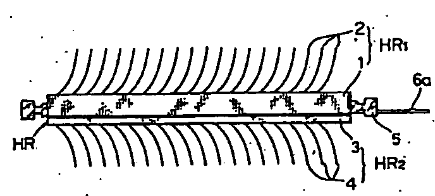
(54) **Positive temperature coefficient thermistor device for heating apparatus.**

(57) A positive temperature coefficient thermistor device adapted for a heating apparatus comprises a board-type positive temperature coefficient thermistor element (7) and a first and a second radiator (HR1, HR2) for radiation adjacently disposed on a front and a rear surface (7a, 7a) of the thermistor element (7); respectively. Each of these radiators (HR1, HR2) has a pair of fitting flanges (1a,1b; 3a,3b) which are, respectively, arranged on a pair of opposed sides of each radiator(HR1,HR2) located so as to meet at right angles with a flow direction of the air to be heated by the positive temperature coefficient thermistor device. Corresponding fitting flanges (1a,3a; 1b,3b) of the first and second radiators (HR1, HR2) are engaged with each other by respective spring pin members (9) which are, respectively, inserted between the surfaces of the facing flanges (1a,3a; 1b,3b) so as for them to be united. The thermistor element (7) is contained in a space surrounded by the first and second radiators (HR1,HR2).

Fig. 1



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Descripti n

POSITIVE TEMPERATURE COEFFICIENT THERMISTOR DEVICE FOR HEATING APPARATUS

The pr sent invention relates t a positive temperature coefficient thermistor device for heating apparatus comprising a positive temperature coefficient thermistor element to be used as a heating element and a radiator.

A heating apparatus adapted for a heater with a fan, an auxiliary heater for an air conditioner, and the like, conventionally, comprises a chrome-alloyed electric heating wire and a radiator which radiates heat generated from the wire. However, there are disadvantages with such heating apparatus as using the electric heating wire, particularly in a safety aspect; that is, abnormal overhearing caused by a failure of an electrical circuit and the like. Thus, a positive temperature coefficient thermistor device for a heating apparatus including a positive temperature coefficient thermistor element(referred, hereinafter, to as a PTC thermistor element) as its heating element has been developed.

Figs. 17 and 18 represent the structure of such positive temperature coefficient thermistor device for heating apparatus. Fig. 17 is a front elevation view of the device and Fig. 18 is a side elevation view of the same. In these Figs., a reference numeral 107 designates a disk-shaped PTC thermistor element, and on both surfaces 170a, 170a of this element 107a, an electrode is organized. Radiating plates 100, 103 are mounted onto the two surfaces 107a, 107a of the element 107 so as for them to be nipped. Radiating fins 102, 104 are attached to the radiating plates 100, 103, respectively, and the air is fed through these radiating plate 100, 103 and radiating fins 102, 104, resulting in the generation of heat. In addition to this structure, there have been developed other conventional structures for the positive coefficient thermistor device for a heating apparatus, such as a so-called harmonica-type device wherein a plurality of PTC thermistor elements are arranged in a ladder form between terminal plates, and the air is fed through spaces between these elements, a device having PTC thermistor elements with a honeycomb-shaped structure, and a device having a radiating plate with corrugated fins to which a PTC thermistor element is adhesively attached. However, in any of these conventional positive temperature coefficient thermistor devices for a heating apparatus, the PTC thermistor elements are directly exposed to the air fed to the radiator which comprises radiating plates and radiating fins. Therefore, there is the possibility of dust entering inside the positive temperature coefficient thermistor devices and deterioration of the PTC thermistor elements. In such a case that a PTC thermistor element and a radiator are assembled by a way of adhesive attachment, the mechanical strength of the device totally decreases. Moreover, since the PTC thermistor elements are directly xposed to the air fed to the radiator as described above, temperature variation differences between the windward side and the leeward side increase; thus, there are disadvantages of low heating efficiency and less generating power, caused by a so-called "pinch effect".

Accordingly, an object of the present invention is to provide an improved positive temperature coefficient thermistor device for a heating apparatus which can overcome the disadvantages described above and which in one embodiment can prevent dust from entering inside the positive temperature coefficient thermistor device so as to prevent the deterioration of the PTC thermistor element.

According to one preferred embodiment of the present invention, there is provided an improved positive temperature coefficient thermistor device for use in a heating apparatus which comprises a board-type positive temperature coefficient thermistor element; a first and a second radiator for radiation adjacently disposed on a front and a rear surface of the PTC thermistor element, respectively, wherein each of the first and second radiators has a pair of fitting flanges which are, respectively, arranged on a pair of opposed sides of each radiator so as to meet at right angles with the flow direction of the air to be heated by the device, corresponding fitting flanges of the first and second radiaters being engaged with eath other by means of respective urging means which are, respectively, inserted between the surfaces of the facing flanges so as for them to be united, and the PTC thermistor element being contained in a space surrounded by the first and the second radiators.

Further, according to one preferred embodiment of the present invention, the device further comprises a frame member which is disposed between the first and the second radiators to position the thermistor element within the space.

According to such structure, the PTC thermistor element accommodated inside the radiator is not directly exposed to the air to be fed to the radiator. In other words, the flange part in each side of the radiator becomes like a screen so as to effectively shut out the air flow into the device. As a result, a phenomenon of "pinch effect" can be prevented.

Moreover, by accommodating the PTC thermistor element in the frame member, the PTC thermistor element can be stored in an enclosed space. The positioning of the thermistor element in the space is also easily carried out.

As described above, advantages of the present invention are as follows:

(1) Owing to the screen-like part formed in the radiator, the phenomenon of "pinch effect" can be prevented and the radiation efficiency in the direction of the air flow is improved. Moreover, by increasing the area of a radiating section because of the flange part, the efficiency of heat transfer in the longitudinal direction of the radiator is improved, as well as the quantity of heat transfer in the direction being at right angles with the direction of the air flow is improved. Consequently, the distribution of temperature of the device is equalized as a

whole.

(2) Since th radiator has the longitudinal fitting flanges in both sides of the radiator, the mechanical strength of the device against a warp and flection in the direction being at right angles with the air flow is improved.

(3) Since the air to be fed to the device does not flow into the device, turbulence can hardly occur when the air passes through the radiator, resulting in that high radiation effect can be achieved.

(4) Owing to the screen-like part provided for the radiator and the frame member surrounding the PTC thermistor element, there is no possibility of dust entering the device and the direct exposure of the element to the air. As a result, deterioration of the PTC thermistor element can be prevented.

These and other objects and features of the present invention will become apparent from the following description taken in conjunction with preferred embodiments thereof with reference to the accompanying drawings, in which:

Figs. 1 and 2 are, respectively, a front elevation view and an end view of the positive temperature coefficient thermistor device according to the first embodiment of the present invention;

Fig. 3 is a perspective view illustrating the inner structure of the device;

Fig. 4 is a sectional side elevation view illustrating the inner structure of the device;

Fig. 5 is a plan elevation view illustrating a form of the terminal plate;

Figs. 6 (A), (B) and (C) are perspective views of spring pins (as urging means) with various forms, which can be applied to the embodiment;

Figs. 7 and 8 are, respectively, a front elevation view and a side elevation view illustrating a state wherein a holder is fitted in the device;

Figs. 9 (A) and (B) are graphes showing the distribution of temperature of the positive temperature coefficient thermistor element in the device;

Figs. 10 and 11 are sectional side elevation views showing the structure of the positive temperature coefficient thermistor device according to a second and a third embodiment of the present invention, respectively;

Figs. 12 and 13 are, respectively a front elevation view and a side elevation view illustrating a state wherein a holder is attached to the device according to either the second or the third embodiment;

Fig. 14 is a section view taken substantially on line A-A of Fig. 12;

Fig. 15 is a section view illustrating the constructed structure of the radiator using a leaf spring instead of the spring pin;

Fig. 16 is a section view taken substantially on line B-B of Fig. 15; and

Figs. 17 and 18 are, respectively, a front view and a side view illustrating the schematic structure of a conventional type PTC thermistor device, as previously described.

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals and symbols throughout the several views of the accompanying drawings.

Referring now to Figs.1 and 2, there is shown a positive temperature coefficient thermistor device for use in a heating apparatus, according to a first embodiment of the present invention. In these drawings, a reference symbol HR designates a radiator, and this radiator can be separated into two portions; a first radiator HR1 and a second radiator HR2. Each of the radiators HR1 and HR2 is comprises a radiating plate 1; 3 and a plurality of radiating fins 2; 4, wherein the radiating fins 2, 4 are formed to be united with the radiating plate 1, 3. A positive temperature coefficient (PTC) thermistor element is incorporated in a space formed by the arrangement of these two radiating plates 1, 3. A reference numeral 5 designates a frame member made of a insulating material which has a function for positioning the PTC thermistor element in the radiator HR and other function. A reference numeral 6a is an outside terminal part of a terminal plate 6 which comes in contact with one electrode of the PTC thermistor element. As shown in Fig. 2, flange parts which will be described later are arranged in both sides of each radiating plate 1, 3, and these flange parts are to be energized by a spring pin 9, respectively, and to be united after being fitted to each other. These two spring pins 9, 9 are cylindrical rod-type springs with a C-shaped section.

Fig. 3 is a perspective view illustrating the inner structure of the device. In Fig. 3, a reference numeral 7 designates the board-type PTC thermistor element, as previously described, and side parts of the PTC thermistor element 7 are surrounded by a frame member 5 which has a dust-proof function and makes the electric insulation and positioning of the PTC thermistor element 7 easy. In this embodiment, two PTC thermistor elements are used,as shown in the drawing.

In Fig. 4, reference numerals 1a and 1b designate fitting flanges of the flange parts formed on both sides of one radiating plate 1, and reference numerals 3a and 3b designate fitting franges of the flange parts formed on both sides of another radiating plate 3. A pair of radiating plates 1, 3 is fitted by means of two spring pins 9, 9, so as for them to be united. Thus, the inside space formed by the two radiating plates 1, 3 is enclosed by these flange parts of the radiating plates 1, 3 and both end parts 5c, 5c (refer to Fig. 3) of the frame member 5. On the bottom of this space, an insulation board 8, a terminal plate 6, and the PTC thermistor element 7 are layered in order, and the frame member 5 is disposed around the element 7 as shown in Fig. 3. On the front and rear surfaces 7a, 7a of the element 7, an electrode is organized. The electrode on the front surface of the PTC thermistor element 7 (on the upper side) is electrically connected to the radiating plat 1, and the electrod on its rear surface is electrically connected to the terminal plate 6,

r sulting in that power supply can be carried ut between the terminal plate 6 and the radiating plate 1.

As shown in Fig.5, the terminal plate 6 made of a metal plate comprises a body p rtion 6c with an approximately identical shape to the inside shape of the frame member 5, a outside terminal part 6a projecting from one shorter side of the frame member 5, and narrow-width parts 6b, 6b formed between the body portion 6c and the outside terminal part 6a. Due to the formation of the narrow-width parts 6b, the terminal plate 6 has a fuse function against an overcurrent. Several holes 5a are punched in the frame member 5 in order that the fusing of the narrow-width parts 6b can be securely carried out. The frame member 5 has a symmetric structure so as to be used in any direction, upside down and/or inside out.

Referring now to Figs. 6 (A) - (C), there are shown spring pins 9 with various forms, to be used at the time of fitting of the flange portions. As previously described, these spring pins 9 are made of a material of a spring metal plate and formed to have a C-shaped section. With respect to the form of the spring pins 9, it is possible to use, in addition to an approximate cylinder-type pin shown in Fig. 6 (A), a type as shown in Fig. 6 (B) comprising a plurality of independent spring pin parts (the parts having a C-shape section) formed on one spring pin, and a plurality of completely independent spring pins as shown in Fig. 6 (C) wherein a plurality of these spring pins are inserted into the flange part of one side. When the electricity is supplied to this device one end of the spring pin 9 is made to be projected from the end part of the radiating plate, and then this spring pin 9 can be used as a terminal of the radiating plate side. In this case, the radiating plate and the spring pin are engaged by means of elastic force, and its fitting can be easily. In addition, since the flange part is located at a part of less heat conduction from the radiation section of the radiator HR, there is no possibility of the deterioration of electrical properties caused by heat on the contact surfaces.

When the positive temperature coefficient thermistor device for heating apparatus comprised in such a way as described above is, for example, installed in a heating apparatus with a fan, installation procedures are as follows: As shown in the Figs. 7 and 8, which are, respectively, a front view and a side view illustrating a state wherein a holder 10 is installed in the above-mentioned device, engagement parts 10b, 10b which are to be engaged with concave parts 5b, 5b formed on two sides of the frame member 5 are provided in the holder 10, and the two holders 10 hold both ends of the frame member 5, respectively. In the holder 10, a notch 10a for use of being screwed is also provided whereby the device can be installed in the heating apparatus with a fan in the direction parallel to the retaining face which is at right angles with the dir ction of the air flow. When the holder 10 is made of electric- and heat-insulating material, the electric insulation and heat resistance between the heating apparatus and the device can be maintained.

Th distribution of temp rature of the PTC thermistor element 7 in the positive temperature coefficient thermistor device described above is shown in Figs. 9 (A) and (B). Fig. 9 (A) shows the distribution f temperature in the lateral direction (the direction of the air flow) of the element, and Fig. 9 (B) shows the distribution of temperature in the longitudinal direction (the direction crossing the direction of the air flow at right angles) of the element. A solid line in the drawing designates the distribution of temperature of the PTC thermistor element according to the above-mentioned embodiment, and A broken line designates the distribution of temperature of the element in the conventional device for the heating apparatus, just for the comparison. Since the flange part is formed in each side of the radiator HR, thermal capacity of the whole radiator increases, and the temperature of the element which contributes to heat conduction rises in general as shown in Fig. 9 (A). Moreover, since the element is not directly exposed to cold air, due to the flange part, the peak of heating temperature of the element is centralized and widened, which means the heat generation from the whole element, leading to the improvement of heating efficiency. This improvement of heating efficiency is related to the distribution of the electric resistance value of the thermistor element itself. For example, when the element is directly exposed to the air under condition that certain current flows in the direction of thickness of the element, in the windward side the element is refrigerated, and therefore, the resistance value of the element around such area lowers, leading to low heating temperature.

On the other hand, in the leeward side the element is relatively less refrigerated, so that the high resistance value is maintained, leading to high heating temperature. As a result, a heating area moves to the leeward side, and the area of heating is reduced. However, when the element is not directly exposed to the air as described in this embodiment, a heating area is evenly extended in the whole element having a central part of the element as its peak, and the area of heating becomes wider. This, consequently, contributes to the relative increase of thermal capacity. Moreover, since the section area taken along the longitudinal direction of the radiator HR increases due to the flange parts on the radiating plates, heat from the element 7 can be fully conducted not only to the radiating fins right above and below the element but also to the other part of the radiating fins. In addition to the above, as shown in Fig. 9 (B), the distribution of temperature is also evened out in the longitudinal direction of the element, thus resulting in that radiation efficiency is improved.

In the first embodiment, one electrode of the PTC thermistor element 7 is connected to the terminal plate 6, and another electrode is directly connected to the radiating plate . However, as shown in Figs. 10 and 11, two terminal plates 6, 16 can be arranged in the device. In a second mbodiment of the present invention shown in Fig. 10, one terminal plate 6 is electrically insulated fr m the radiating plate 3 by means of the insulating board 8 while another

terminal plate 16 is directly arranged between the element and the radiating plate 1. In this structure, there is a distinctive feature that electrically high-reliable materials can be freely selected as a material f r the terminal plate, regardless of material of the radiating plates, by using a terminal for exclusive use of power supply. In a third embodiment of the present invention shown in Fig. 11, both of terminal plates 6, 16 are electrically insulated from the radiating plates by means of insulating boards 8, 18. Since an electric shock and leakage can be prevented in this embodiment, installation in apparatuses can be facilitated.

Figs. 12 - 14 illustrate a state wherein a holder is attached to the above-mentioned positive temperature coefficient thermistor device having two terminal plates 6, 16. Figs. 12 and 13 are a front view and a side view of the device having the holder 10, and Fig. 14 is a section view taken substantially on line A-A of Fig. 12. As shown in Fig. 14, the terminal plates 6, 16 are nipped by an engagement part of the holder 10, 10 and the frame member 5 so as to be fixed,as previously described. With the holders 10 being engaged with both end parts of the frame member 5, the positioning and fixation of the terminal plates 6, 16 are carried out simultaneously with the fixation of the holders 10, 10 to the frame member 5.

In any of the above-mentioned embodiments, the spring pin 9 is inserted between the fitting flanges formed on both sides of two radiating plates, however, the structure shown in Figs. 15 and 16 is also applicable. A reference numeral 19 designates a metal leaf spring with a corrugated shape and a reference numeral 11 designates an elastic element, such as a rubber sheet and a room-temperature hardening-type resin sheet. Such formation of the elastic element also securely prevents dust and moisture from entering through the side parts of the device.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be noted, here, that various changes and modifications will be apparent to those skilled in the art. For example, the above-mentioned device can be used as a device for current control without any change. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as included therein.

Claims

1. A positive temperature coefficient thermistor device adapted for a heating apparatus which comprises a board-type positive temperature coefficient thermistor element (7) and a first and a second radiator (HR1, HR2) for radiation adjacently disposed on a front and a rear surface(7a, 7a) of said thermistor element(7),respectively,
wherein each of said first and second radiators (HR1, HR2) has a pair of fitting flanges (1a, 1b; 3a, 3b) which are arranged, respectively, on a pair of oppos d sides of said each radiator (HR1, HR2) located so as to meet at right angles with th flow direction of the air to be heated by said positive temperature coefficient thermistor device, corresponding fitting flanges(1a, 3a; 1b,3b) of said first and second radiators (HR1, HR2) being engaged with each other by means of respective urging means(g) which are, respectively, inserted between the surfaces of the facing flanges (1a,3a;1b,3b) so as for them to be united, and said thermistor element (7) being contained in a space surrounded by said first and second radiators (HR1, HR2).

2. A positive temperature coefficient thermistor device as set forth in claim 1, wherein said urging means (9) is a pin member cylindrically formed of a material of a sheet spring and having a C-shaped section.

3. A positive temperature coefficient thermistor device as set forth in claim 1, wherein said urging means (9) is a elongated corrugated sheet-type spring member.

4. A positive temperature coefficient thermistor device as set forth in any of claims 1 to 3, further comprising a frame member (5) which is disposed between said first and second radiators (HR1, HR2) to position said thermistor element (7) within said space.

5. A positive temperature coefficient thermistor device as set forth in claim 4, further comprising a pair of holders (10) each of which integratedly clamps ends of said first and second radiators(HR1, HR2) and said frame member (5).

6. A positive temperature coefficient thermistor device as set forth in any preceding claim, further comprising a terminal plate (6) disposed at, at least, one space between said thermistor element (7) and said first and second radiators (HR1, HR2).

7. A positive temperature coefficient thermistor device as set forth in claim 6, wherein said terminal plate (6) comprises a body portion (6c), an outside terminal part (6a), and a narrow-width part for connecting these two parts (6c and 6a).

8. A positive temperature coefficient thermistor device as set forth in claim 6 or claim 7, further comprising an insulating board (8, 18) disposed between said terminal plate (6) and the corresponding radiator (HR1, HR2).

9. A positive temperature coefficient thermistor device as set forth in any preceding claim, wherein each of said first and second radiators (HR1, HR2) comprises a radiating plate (1, 3) having said fitting flanges (1a, 1b; 3a, 3b) on a pair of the opposed sides thereof, and a plurality of radiating fins (2, 4) formed on the outer surface of said radiating plate (1, 3), said radiating fins (2, 4) being formed to be integrated with said radiating plate (1, 3) by cutting and raising a part of said radiating plat (1, 3).

Fig. 1

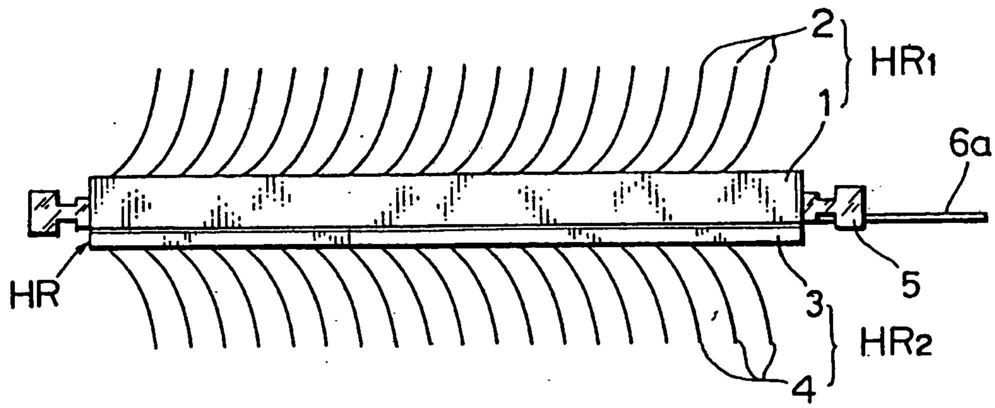


Fig. 2

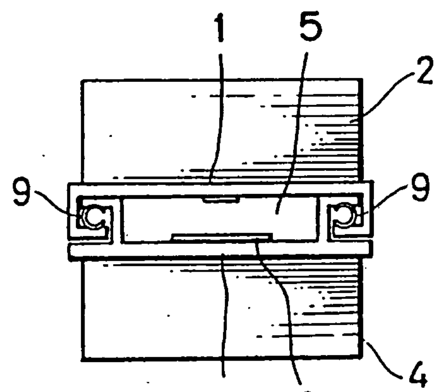


Fig. 3

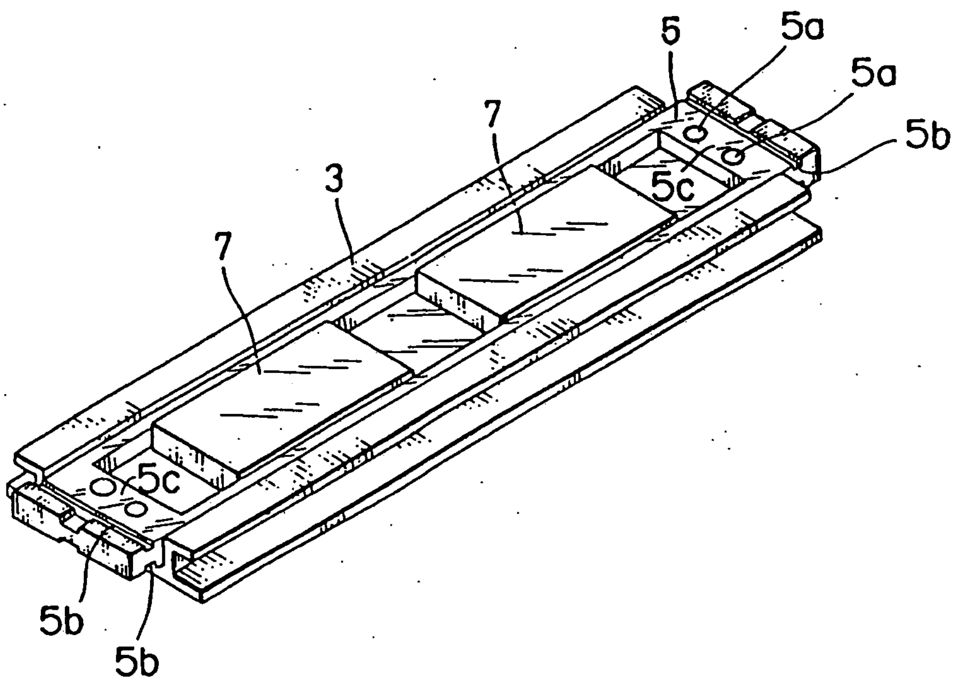


Fig. 4

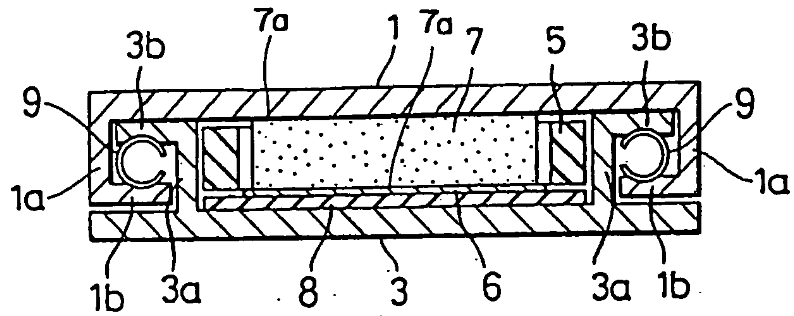
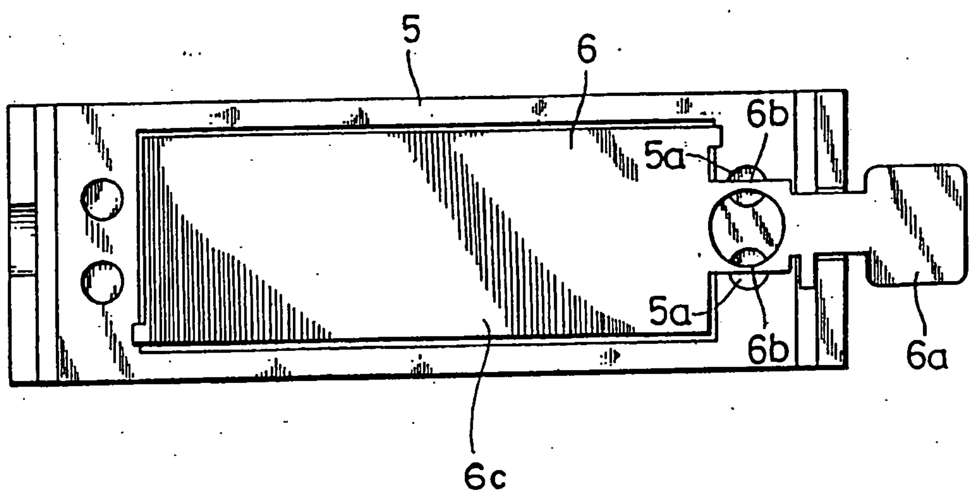


Fig. 5



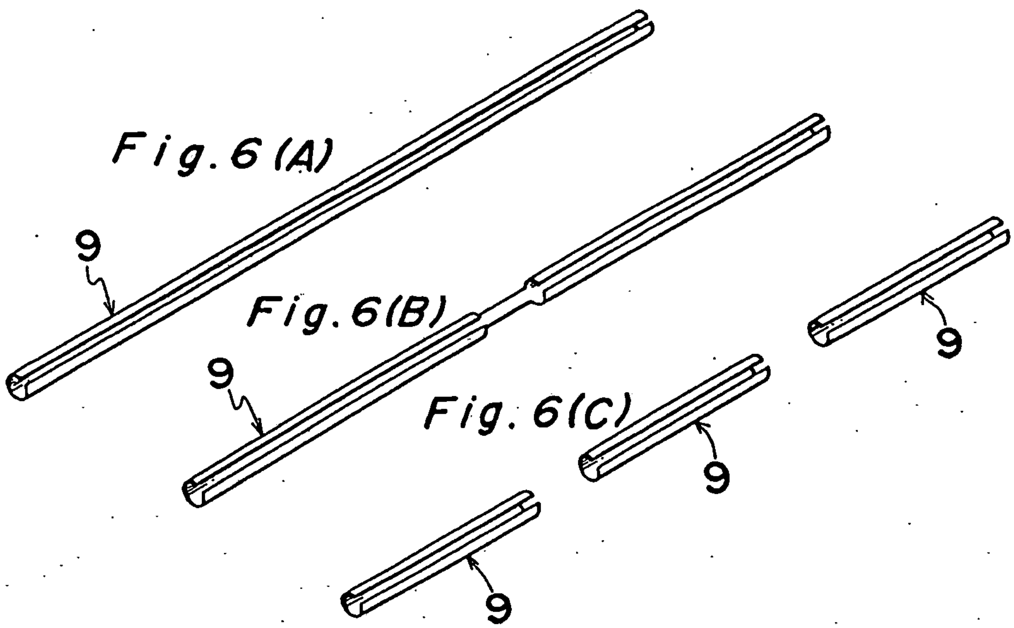


Fig. 6 (A)

Fig. 6 (B)

Fig. 6 (C)

Fig. 7

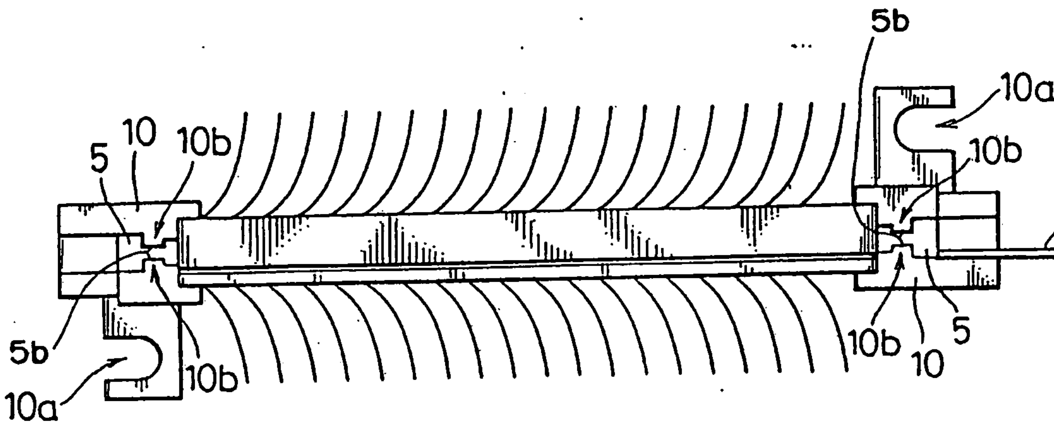


Fig. 8

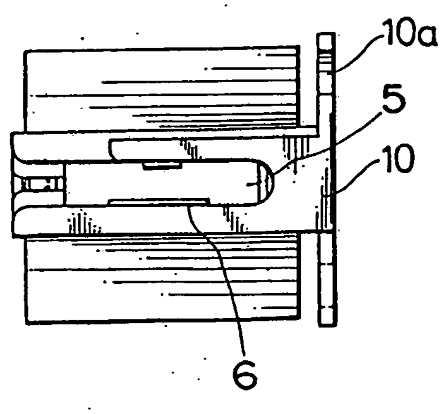


Fig. 9 (A)

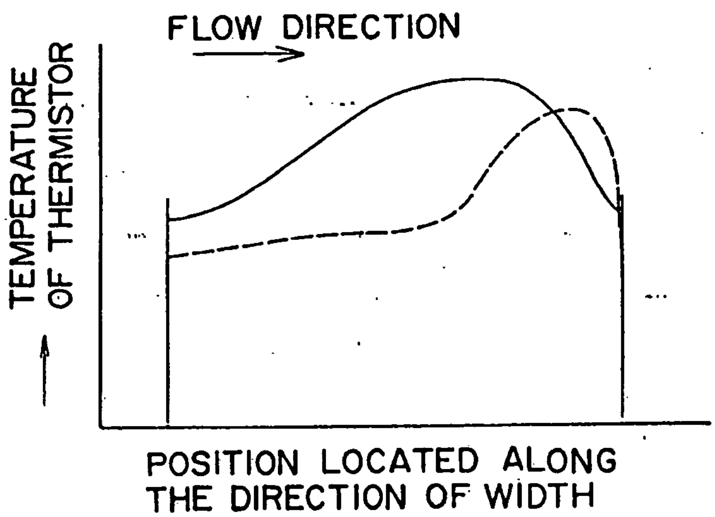

FLOW DIRECTION
TEMPERATURE OF THERMISTOR
POSITION LOCATED ALONG THE DIRECTION OF WIDTH

Fig. 9 (B)

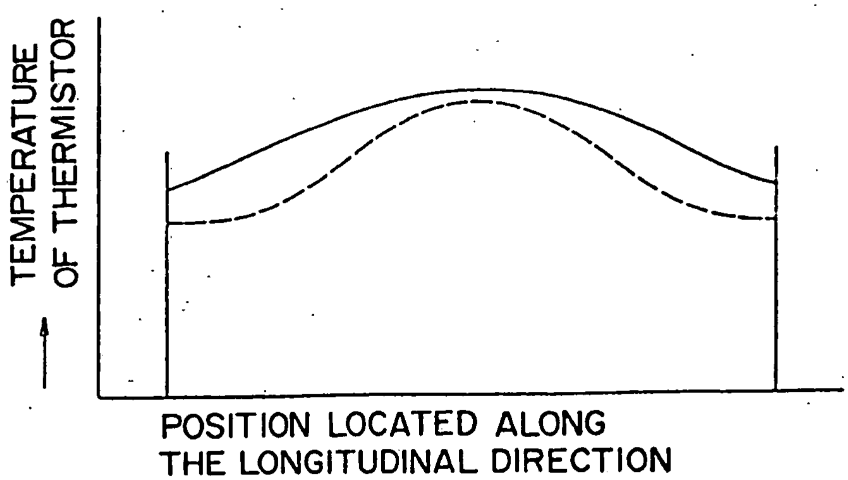

TEMPERATURE OF THERMISTOR
POSITION LOCATED ALONG THE LONGITUDINAL DIRECTION

Fig. 10

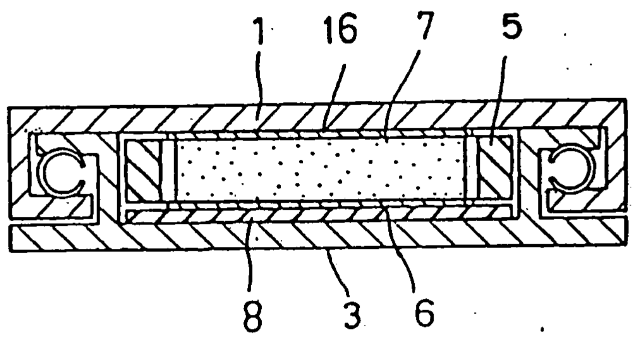


Fig. 11

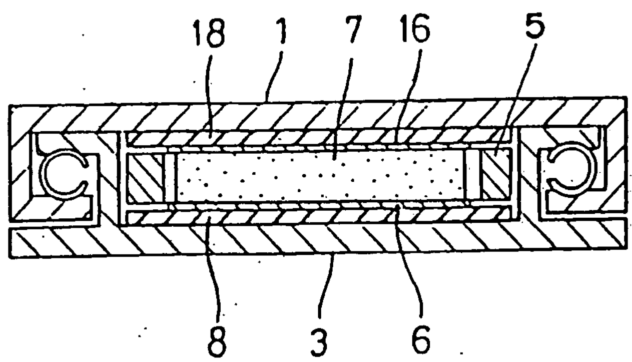


Fig. 12

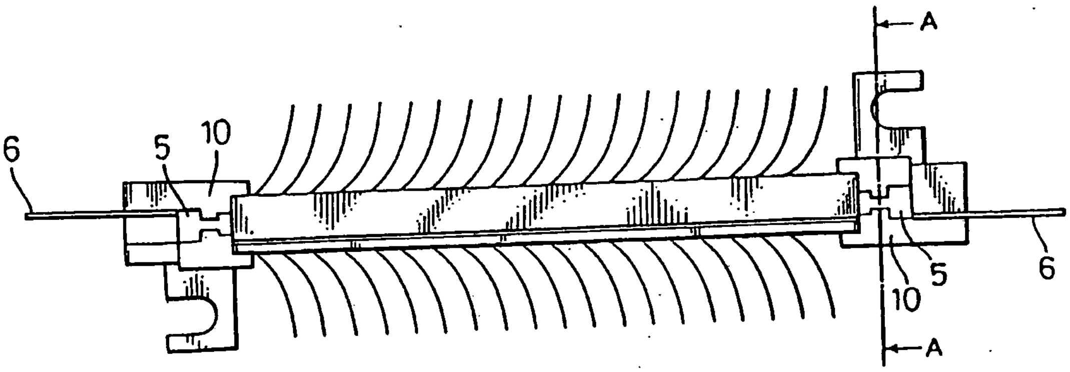


Fig. 13

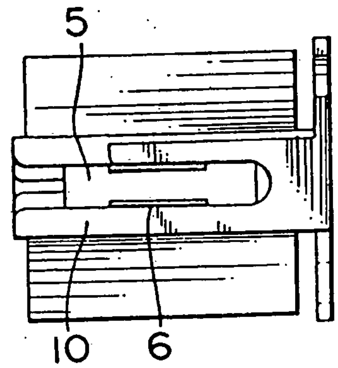


Fig. 14

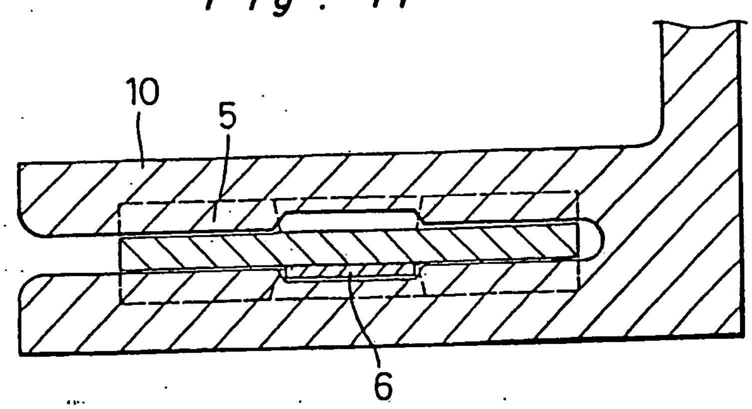


Fig. 15

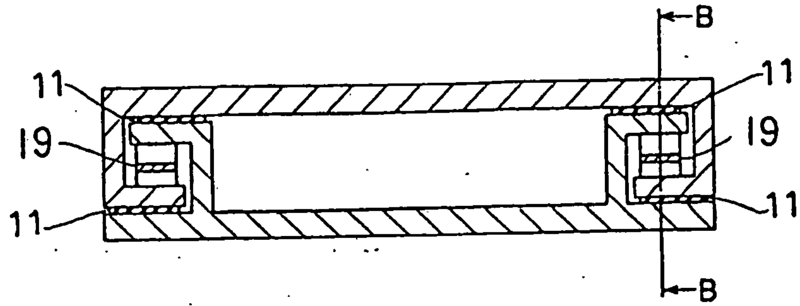


Fig. 16

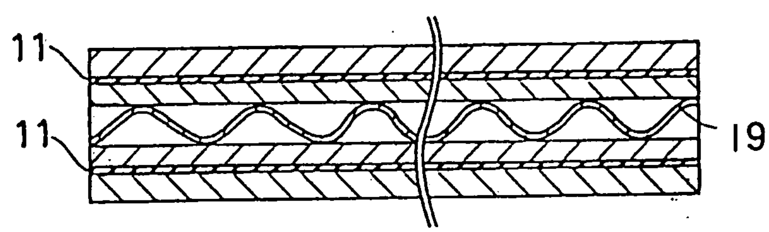


Fig. 17
PRIOR ART

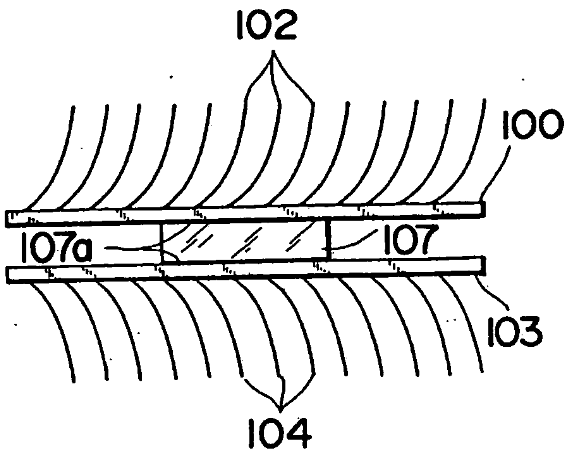
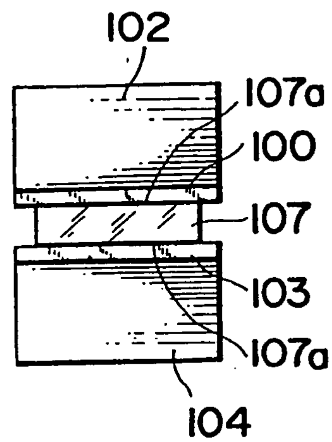


Fig. 18
PRIOR ART



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 30 8341

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	EP-A-0 019 376 (MURATA MANUFACTURING CO.) * Page 31, line 18 - page 35, line 5; figures 30-34 *	1,2,4,6,7	H 05 B 3/14
A	DE-A-3 119 302 (MATSUSHITA) * Page 9, line 7 - page 10, line 17; figures 2A,B *	1,6,9	
A	DE-A-2 948 593 (EICHENAUER) * Page 9, line 6 - page 10, line 7; figures 2,3 *	1,3,6,7	
A	FR-A-2 257 184 (SPETSIALNOE KONSTRUKTORSKOE BJURO "TRANSNEFTEAVTOMATIKA") * Page 8, lines 12-15; figures 5,6 *	1	
A	DE-A-3 042 420 (EICHENAUER) * Page 9, line 20 - page 10, line 26; figures *	1,4,6-8	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	DE-A-3 208 802 (C.S. FUDICKAR)		H 05 B 3/00
A	FR-A-2 580 451 (ZAEGEL-HELD)		
A	FR-A-2 439 530 (EICHENAUER)		
A	GB-A-1 034 594 (CASTLE CASTINGS)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25-11-1988	RAUSCH R.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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